IN THE CLAIMS

Listing of Claims:

1. (Original) A method of estimating a motion vector for a target block of pixels in a target frame relative to a reference frame, the method comprising:

defining a search area of the reference frame;

defining a plurality of K search sets $S_1..S_K$ based on the search area, each search set S_i, for i=1 to K, identifying pixels from an i-th column or row of the search area, with each pixel in each search set identifying a respective block of pixels;

determining a set of K candidate blocks $B_1..B_K$, with each block B_i, for i=1 to K, identified by a pixel in search set S_i and minimizing a first distortion function relative to the target block, the first distortion function based only on a set of two or more collinear pixels from the target block and a set of two or more collinear pixels from block B_i;

determining which of the K candidate blocks $B_1..B_K$ minimizes a second distortion function relative to the target block; and

estimating the motion vector based on the target block and one of the K candidate blocks that minimizes the second distortion function.

2. (Original) The method of claim 1:

wherein the search area includes N rows or columns, with N >K; and

wherein each search set S_i only identifies one or more pixels from the i-th row or column and one or more pixels from every (i+nK)-th row or column of the search area, which satisfies: i+nK N, for n = 1, 2, 3, and so on.

3. (Original) The method of claim 1, wherein each pixel in each search set occupies the upper left position of its associated block of pixels.

4. (Original) The method of claim 1, wherein each row or column of pixels in the search area consists of a first number of pixels; and wherein each search set S_i identifies less than the first number of pixels.

5. (Original) The method of claim 1, wherein the set of two or more collinear pixels from the target block consists of pixels in the i-th row or column of the target block and the set of

two or more collinear pixels from block B_i consists of pixels from the i-th row or column of block B_i.

6. (Original) The method of claim 1, wherein the plurality of K search sets $S_1..S_K$ are mutually exclusive.

7. (Original) The method of claim 1, wherein the second distortion function is based on all the pixels of the target block.

8. (Original) The method of claim 1, wherein the recited acts are performed in the recited order.

9. (Original) The method of claim 1, wherein K is 16 and each block consists of 16 rows or 16 columns.

10. (Original) A method of estimating a motion vector for a target block of pixels in a target frame relative to a reference frame, the method comprising:

determining a first plurality of partial distortion measures, each based only on a first row or column of pixels of the target block and a corresponding first row or column in a respective one of a first plurality of blocks in the reference frame, the first plurality of blocks including a first minimum block associated with a minimum of the first plurality of distortion measures;

determining a second plurality of partial distortion measures, each based only on a second row or column of pixels of the target block and a corresponding second row in a respective one of a second plurality of blocks in the reference frame, with the second plurality of blocks including a second minimum block associated with a minimum of the second plurality of distortion measures;

determining a first distortion measure based at least on pixels of the target block and the first minimum block that are outside the first row or column of the target block and the first minimum block;

determining a second distortion measure based at least on pixels of the target block and the second minimum block that are outside the second row or column of the target block; and

determining the motion vector based on the target block and the one of the first and second minimum blocks associated with the lesser of the first and second distortion measures.

11. (Original) The method of claim 10:

wherein each first partial-distortion measure is based on all the pixels in the first row of the target block and all the pixels in the corresponding first row of its respective block in the first plurality of blocks;

wherein the first distortion measure is based on all the pixels of the target block and the first minimum block and the second distortion measure is based on all the pixels of the target block and the second minimum block; and

wherein the recited acts are performed in the order recited.

12. (Original) The method of claim 10:

wherein each block in the first and second pluralities of blocks is rectangular, and is identified by coordinates of its upper left pixel, with each upper left pixel within a search area of the reference frame, the search area having a plurality of columns of pixels, including at least one first column and at least one second column; and

wherein the upper left pixel of each of the first plurality of blocks is within a first column of the search area, and the upper left pixel of each of the second plurality of blocks is within a second column of the search area.

13. (Original) The method of claim 12, wherein each column of the search area consists of N pixels and each of the first and second pluralities of blocks includes less than N blocks.

14. (Original) The method of claim 12:

wherein the first and second pluralities of blocks are mutually exclusive; and

wherein the search area includes more than one first column and more than one second column, with the first plurality of blocks including at least one block from each first column and the second plurality of blocks including at least one block from each second column.

15. (Original) The method of claim 10, wherein each first partial distortion measure is based on a sum of absolute differences of the pixels in the first row of the target block and pixels in the corresponding first row of its respective block in the first plurality of blocks.

16. (Original) An image encoder including a motion estimator for estimating a motion vector for a target block of pixels in a target frame relative to a reference frame, the motion estimator comprising:

means for defining a search area of the reference frame;

means for defining a plurality of K search sets $S_1..S_K$ within the search area, each search set S_i, for i=1 to K, identifying pixels from an i-th column of the search area, with each pixel in each search set associated with a block of pixels;

means for determining a set of K candidate blocks $B_1..B_K$, with each block B_i, for i=1 to K, corresponding to one block of pixels associated with a pixel of search set S_i and minimizing a first distortion function relative to the target block, the first distortion function based only on a set of two or more collinear pixels from the target block and a set of two or more collinear pixels from block B_i;

means for determining which one of the K candidate blocks $B_1..B_K$ minimizes a second distortion function relative to the target block; and

means for estimating the motion vector based on the target block and the one of the K candidate blocks that minimizes the second distortion function.

17. (Original) The image encoder of claim 16, wherein the set of two or more collinear pixels from block B_i comprises two or more pixels from a row of pixels in block B_i.

18. (Original) The image encoder of claim 16:

wherein the search area includes N rows or columns, with N >K;

wherein each search set S_i identifies one or more pixels from the i-th row or column and one or more pixels from every (i+nK)-th row or column of the search area, which satisfies:

i+nK N, for n = 1, 2, 3, and so on; and

wherein the first and second distortion functions are based on a sum of absolute differences.

19. (Original) A machine-readable medium for facilitating estimation of a motion vector for a target block of pixels in a target frame relative to a reference frame, the medium comprising instructions for:

defining a search area of the reference frame;

defining a plurality of K search sets $S_1..S_K$ within the search area, each search set S_i, for i=1 to K, identifying pixels from an i-th column of the search area, with each pixel in each search set S_i associated with a block of pixels;

determining a set of K candidate blocks $B_1..B_K$, with each block B_i, for i=1 to K, corresponding to one block of pixels associated with a pixel of search set S_i and minimizing a first distortion function relative to the target block, the first distortion function based only on a set of two or more collinear pixels from the target block and a set of two or more collinear pixels from block B_i;

determining which one of the K candidate blocks $B_1..B_K$ minimizes a second distortion function relative to the target block; and

estimating the motion vector based on the target block and the one of the K candidate blocks that minimizes the second distortion function.

20. (Original) The medium of claim 19, wherein each pixel in each search set occupies the upper left position of its associated block of pixels.

21. (Original) The medium of claim 19, wherein each column of pixels in the search area consists of a first number of pixels; and wherein each search set S_i identifies less than the number of pixels in the i-th column.

22. (Original) The medium of claim 19, wherein the set of two or more collinear pixels from the target block consists of pixels on the i-th line or row of the target block, and the set of two or more collinear pixels from block B_i consists of pixels on the i-th line or row of block B_i.

23. (Original) The medium of claim 19:

wherein the search area includes N rows or columns, with N >K; and

wherein each search set S_i only identifies one or more pixels from the i-th row or column and one or more pixels from every (i+nK)-th row or column of the search area, which satisfies: i+nK N, for n = 1, 2, 3, and so on.

24. (Original) The medium of claim 19, wherein the second distortion function is based on all the pixels of the target block.

25. (Original) A system comprising:

at least one processor;

an image decoder coupled to the processor; and

an image encoder coupled to the processor, with the image encoder including a motion estimator for estimating a motion vector for a target block of pixels in a target frame relative to a reference frame, the motion estimator comprising:

means for defining a search area of the reference frame;

means for defining a plurality of K search sets $S_1..S_K$ within the search area, each search set S_i, for i=1 to K, identifying pixels from every i-th column of the search area, with each pixel in each search set S_i identifying a block of pixels;

means for determining a set of K candidate blocks $B_1..B_K$, with each block B_i, for i=1 to K, corresponding to one block of pixels identified by a pixel of search set S_i and minimizing a first distortion function relative to the target block, the first distortion function based only on a set of two or more collinear pixels from the target block and a set of two or more collinear pixels from block B_i;

means for determining which one of the K candidate blocks $B_1..B_K$ minimizes a second distortion function relative to the target block; and

means for estimating the motion vector based on the target block and the one of the K candidate blocks that minimizes the second distortion function.

26. (Original) The image encoder of claim 25, wherein the set of two or more collinear pixels from block B_i comprises two or more pixels from a line of pixels in block B_i.

27. (Original) An image encoder including a motion estimator for estimating a motion vector for a target block of pixels in a target frame relative to a reference frame, the motion estimator comprising:

a first minimization module that determines a set of K candidate blocks $B_1..B_K$, with each block B_i, for i=1 to K, minimizing a respective first distortion function relative to the target block, the respective distortion function based only on a set of two or more collinear pixels from the i-th row or column of the target block and a set of two or more collinear pixels from the i-th row or column of block B_i;

a second minimization module that determines which of the K candidate blocks $B_1..B_K$ minimizes a second distortion function based at least on pixels outside the i-th row or column of the target block; and

an estimation module that estimates the motion vector based on the target block and one of the K candidate blocks that minimizes the second distortion function.

28. (Original) A system comprising:

at least one processor;

an image decoder coupled to the processor; and

the image encoder of claim 27 coupled to the processor.

29. (Original) A method of estimating a motion vector for a target block of pixels in a target frame relative to a reference frame, with the target block having two or more lines of pixels, the method comprising:

identifying a set of two or more candidate blocks in the reference frame, with each candidate block minimizing a first distortion function based on only one respective line of pixels of the target block and a corresponding line of pixels in the candidate block, the one respective line being different for each candidate block;

determining which one or more of the candidate blocks minimizes a second distortion function based on pixels from more than two lines of the target block; and

determining the motion vector based on one of the candidate blocks that minimizes the second distortion function.

30. (Original) The method of claim 29, wherein each block comprises two or more rows of pixels, and each line of pixels comprises pixels from one respective row of pixels.